

REMARKS**A. Status of the Claims**

Claims 1-8, 12-14, 16, and 19 are pending in the application. Claims 1-8, 12-14, 16, and 19 were rejected under 35 USC 103(a) as being unpatentable over Oota et al., EP 0359886 in view of Huff et al., US Patent No. 5,950,107.

B. 35 USC 103 Rejection: Oota et al. and Huff et al.

Claims 1-8, 12-14, 16, and 19 were rejected under 35 USC 103(a) as unpatentable over Oota et al. in view of Huff et al. Note that in the Office Action of September 15, 2004, the Examiner refers to this reference as "Mimura et al." European Patent Application 0395886, however, lists six inventors. The first named inventor is Oota, Yoshinori, while the third is Mimura, Yoshiyuki. Applicants presume this to be the intended reference, and will refer to it herein as Oota et al.

As amended, claim 1 recites a method for making a semiconductor device, comprising: providing a metal structure comprising tungsten on a substrate; providing an insulating layer over the metal structure; providing a capping structure over the insulating layer; and annealing the resulting structure, wherein a portion of the metal structure has a width greater than about 1 micron, wherein the capping structure and annealing prevents peeling of the metal structure when heated.

As the Examiner points out, neither Oota et al. nor Huff et al. teach a width of a metal structure greater than about 1 micron, as recited in the claim. The Examiner suggests modifying the invention of Oota et al. to use a tungsten material as in Huff. The Examiner continues:

In addition, the combined teaching of Mirmura and Huff would have been obvious to construct a portion of the metal structure to be about 1 micron thick in width, since it is *prima facie* obvious to an artisan to make a portion of the

metal structure with a specific range of the width for optimization and experimentation because applicants have not yet established any criticality for the specific width, as claimed.

As explained in the present application, and in the prior response, tungsten structures can often peel, delaminating from the underlying structure, during heat treatments and especially during aggressive heat treatments, e.g., those lasting for about 1 minute at a temperature of about 800°C. This problem can be particularly acute for large areas of tungsten, for example areas having a width about 1 micron or more. A conventional approach to this problem is to avoid it, establishing design rules that prohibit the use of tungsten features having a width of about 1 micron or more. (For example, see paragraph [07] of the specification.)

Thus the range recited in the claim in fact is critical, since it is in this range that the problem solved by the invention most frequently occurs, and that the benefit of the present invention becomes felt. Further, because it is known that tungsten tends to peel away from underlying dielectric when the width of the tungsten features exceeds about 1 micron, it would *not* be routine for one skilled in the art to make tungsten structures having this width; rather a skilled artisan would tend to avoid features of this range. Thus the suggested modification is not obvious.

Neither Oota et al. nor Huff et al. teach tungsten structures having a width of about 1 micron or more, and Applicants have shown that one skilled in the art would be motivated to avoid this range because of the known problem of tungsten peeling from an underlying structure.

In addition, as amended, claim 1 (and the other independent claims 12, 13, 14, 16, and 19) recite that the capping structure and annealing prevents peeling of the metal structure when heated. Neither of the cited references addresses the problem of tungsten peeling; i.e. of tungsten failing to adhere to and peeling away from underlying metal structure (see paragraphs [09], [27],

and [37] of the present application, for example) as in the present invention. Huff et al. refers to peeling of a dielectric layer from a tungsten layer *beneath* it, an entirely different phenomenon, and suggests an unrelated remedy, treating the top layer of the tungsten to enhance adhesion of the dielectric to it (see Abstract, col. 1, lines 27-48, and col. 3, lines 55-64, *inter alia*.) To reiterate, the peeling of concern in the present invention is of tungsten from a dielectric layer *beneath* it, while the peeling of Huff et al. is of a dielectric layer *above* the tungsten from the tungsten beneath it; a different problem with an unrelated solution.

Applicants have shown that the width recited in claim 1, 1 micron, is critical, not routine, and that making features of this width would not be obvious to the skilled artisan. Applicants have further shown that neither cited reference teaches prevention of tungsten peeling from an underlying structure by anneal as recited in the claim. Thus Applicants believe that claim 1 has been shown to be patentable over the cited references.

Independent claims 12, 13, 14, 16, and 19 share the limitations of claim 1 that the tungsten features are at least 1 micron wide and that the anneal, or capping structure and anneal, serve to prevent peeling of the tungsten, and thus are also patentable over the references by the same rationale.

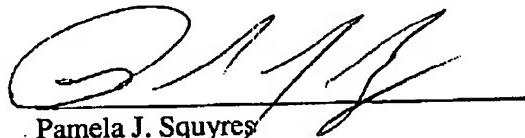
Applicants respectfully request reconsideration of the 35 USC 103(a) rejection of claims 1-5, 7, 8, 12-14, 16, and 19. Claim 6 has been cancelled.

CONCLUSION

In view of the preceding Remarks, Applicants submit that this application is in condition for allowance. Reconsideration is respectfully requested. If objections remain, Applicants respectfully request an interview. In the event that objections remain, the Examiner is invited to contact the undersigned Agent for Applicants at 408-869-2921.

Respectfully submitted,

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Date



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